IDS #7

09/485,500

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04N 13/00, 15/00, G02B 27/22, G03B 35/00 — A1

(11) International Publication Number: WO 99/09750

(43) International Publication Date: 25 February 1999 (25.02.99)

(21) International Application Number: PCT/AU98/00635

(22) International Filing Date: 12 August 1998 (12.08.98)

(30) Priority Data:
PO 8523 12 August 1997 (12.08.97) AU

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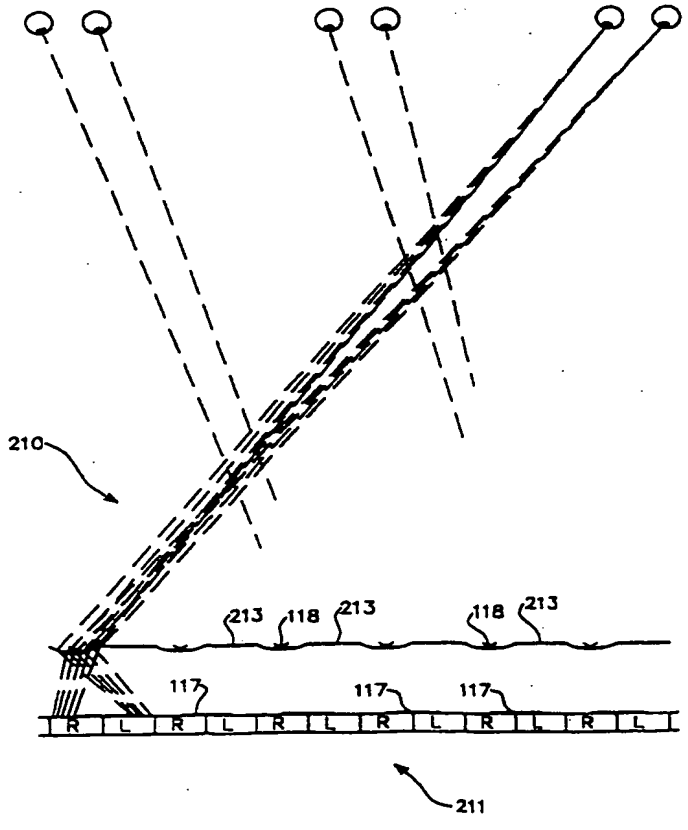
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: STEREOSCOPIC VIEWING SYSTEM

(57) Abstract

A stereoscopic viewing system (10, 110, 210) comprising a raw image (11, 111, 211) having overlaid thereover a distance D therefrom a mask (12, 112, 212) the mask including opaque strips, (17, 117, 217) therein arranged so as to overlay portions of respective right and left image strips (13, 14, 113, 114). In a particular version opaque strips are included as part of the raw image (11, 111, 211) and also as part of the mask (112, 212) or both.



STEREOSCOPIC VIEWING SYSTEM

The present invention relates to a stereoscopic viewing system and, more particularly, to such a system adapted for viewing a stereoscopic image without the aid of spectacles or similar image separating device located close to the eyes of a viewer.

BACKGROUND

Forms of stereoscopic television/video systems which provide stereoscopic viewing without the use of glasses or other encumbrances placed close to the eyes of a viewer are known. Once such system is the so-called lenticular system wherein the image for viewing is made up of interleaved vertical image strips from two (left image and right image) camera views. In order to allow the eyes to resolve the two images into a single stereoscopic image, lenses in the form of vertically arranged contiguous cylindric lenses overlay the vertical image strips whereby, by refraction, the left image is directed towards the left eye of a viewer and the right image is directed towards the right eye of a viewer when the eyes are placed in a predetermined focal plane, or very near thereto. U.S. Patent No. 5,258,833 to Schenk describes this general background with reference to U.S. Patent No. 4,214,257 (Yamauchi) and U.S. Patent No. 2,543,793 (Marks). The systems described in those patents suffer from a sensitivity in the location of the focal plane for viewing and suffer from a large amount of light scatter.

It is an object of the present invention to ameliorate the above-mentioned problem and/or at least provide a useful alternative.

BRIEF DESCRIPTION OF INVENTION

Accordingly, in one broad form of the invention, there is provided a stereoscopic viewing system comprising a raw image overlaid by a mask arranged so that a viewer can resolve a stereoscopic image derived from said raw image in

a focal plane of predetermined width located a predetermined distance from said mask.

Preferably said raw image is comprised of alternating left image strips and right image strips on both of pitch P.

Preferably said mask includes vertical lenticular lens strips corresponding to said left and right image strips and arranged to refract light received therefrom so as to cause a stereoscopic image to be resolved by said viewer in said focal plane.

Preferably said mask further includes opaque vertical strips interposed in between said lenticular lens strips.

Preferably said opaque strips are of pitch P and overlay half the width of adjacent left and right image strips.

Preferably said raw image includes raw image opaque strips interposed between said alternating left image strips and right image strips.

Preferably said lenticular lens strips are in the form of tri-elliptical lenses.

In an alternative preferred form said lenticular lens strips are in the form of a circular cross-section lens.

Preferably said circular cross-section lens is formed as a series of adjacent, planar approximations.

Preferably said mask is formed as a base elongate portion of optical material into a first surface of which are formed lens elements.

Preferably said base elongate portion includes opaque strips placed on said first surface between said lens elements.

BRIEF DESCRIPTION OF DRAWINGS

Embodiments of the invention will now be described with reference to the accompanying drawings wherein:-

Figure 1 illustrates the general layout of a stereoscopic viewing system to which embodiments of the present invention can be applied;

Figure 2 illustrates steps in the formation of a raw stereoscopic image to which a first embodiment of the invention can be applied;

Figure 3 illustrates a mask applicable to the raw image of Figure 2 according to a first embodiment of the invention;

Figure 4 illustrates a mask applicable to a flat panel or plasma display;

Figure 5 illustrates a specific driver circuit for the production of an active raw image;

Figure 6 illustrates an arrangement of raw image and mask according to a further embodiment of the invention;

Figure 7 illustrates a raw image and mask layout according to a further embodiment of the invention;

Figure 8 is a detailed view in cross section of the mask of Figure 7; and

Figure 9 is a detailed view in side section of a mask according to a further embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

With reference to Figure 1, there is shown a stereoscopic viewing system 10 comprising a raw image 11 and a mask 12. The mask 12 includes an optical arrangement whereby light rays from the raw image 11 are directed to either the left eye 13 or right eye 14 of a viewer 15 so as to form a three-dimensional image to the viewer.

With reference to Figures 2A and 2B, the raw image 11 is formed as follows:-

A stereoscopic image is generated initially as two separate images comprising a left eye view and a right eye view. The left eye view is labelled image A whilst the right eye view is labelled image B. Each image is then divided up into vertical strips of pitch P. Figure 2A represents the left image thus partitioned. Figure 2B represents the right eye image thus partitioned. Consecutive strips are then interchanged between the two images as indicated by the arrows thereby to produce a raw image 11 which combines both the left and right images in it in alternating strips as shown.

The raw image may be in the form of a photograph or like 'passive'/reflective image source or it may be in the form of a video display or like 'active'/light emitting image source. In either case, light reflected from or light emanating from the raw image needs to be optically processed through a mask 12 so as to redirect the light rays for reconstruction by eyes 13, 14.

EP744872 discloses a particular implementation of this kind of stereoscopic image system wherein the mask 12 (termed barrier 2 in EP744872) is an electronically controlled shutter mechanism which can dynamically switch and direct the respective right and left images to the respective right and left observer eyes.

As previously discussed the light refracting element of a "lenticular" system more often includes a lens such as lens element 48 shown, for example, in Figure 31A of EP744872.

The particular implementation illustrated in Figs. 2A and 2B shows strip widths for the alternating left eye images A and right eye images B of width or pitch P. A good summary of the history and implementation of this kind of system is to be found in IEEE publication "Present Status of Three-Dimensional Television Research" in Proceedings of IEEE volume 83, No 7 July 1995.

With reference to Figure 3 an implementation of the mask 12 according to a first embodiment of the invention is illustrated. Specifically Figure 3A shows the raw image 11 to which the mask 12 of Figure 3B is applied or overlaid, and including opaque strips 17 as illustrated. The displacement or distance D between the raw image 11 and the mask 12 can, according to the implementation, vary between 0 and typically around 2-13cms depending on the nature of the light refracting element used to form the lens strips 16.

The raw image 11 of Figure 3A comprising alternating vertical strips of left image A and right image B is overlaid by the mask generally illustrated in Figure 3B. The mask comprises vertical lens strips 16 of pitch P arranged to overlay a half-width of a left image strip and a half-width of a right image strip. The lens strips 16 are of the lenticular type and can be constructed in the manner described in U.S. Patent No. 5,258,833.

Interposed between the lens strips 16 are opaque strips 17, also of pitch P and also arranged so as to overlay a half-width of adjacent left image strips and right image strips A, B as generally illustrated in Figure 3B.

With reference to Figure 4, the manner of construction of a colour raw image 18 is illustrated in Figure 4A and comprises alternating left image colour strips 19 and right image colour strips 20. Each image strip is, itself, comprised of three primary colour strips labelled R (red) G (green) and B (blue). The corresponding colour mask 21 is illustrated in Figure 4B and comprises left vertical lens strips 22 and alternating right vertical lens strips 23, each constructed according to the lenticular methods previously known. In addition, an opaque strip 24 is placed, as illustrated in Figure 4B immediately between adjacent vertical lens strips 22, 23 and, correspondingly, 23, 22. The pitch of the opaque strip 24 is such as to cover a primary colour strip, a different colour strip in each consecutive occurrence.

In this manner, it will be noted that the opaque strips remove some redundant image information according to a predetermined algorithm. The effect, it is postulated, is to widen the width W of the focal plane 25 of viewer 15 in which a stereoscopic image can be resolved.

Figure 5 illustrates a driver arrangement suitable for use with the embodiments of the invention where an active display (such as a CRT, LEDs or back lit matrix) wherein a parallax image source 26 resolves a stereoscopic image comprising a left eye image A and a right eye image B into an A data stream 27 and a B data stream 28 which are fed to screen driver 29 which resolves the data streams 27, 28 into respective vertical strip data streams 30, 31 which are directed to the respective vertical strips comprising raw image 11.

Figure 6 illustrates in plan view a further embodiment of the invention comprising raw image 111 made up of respective left image strips 113 and right image strips 114, all of equal width or pitch P and having opaque strips 117 or width or pitch P laid thereover on the viewing side as illustrated in Figure 6. Specifically the opaque strips 117 are of width or pitch P and are arranged so that each overlies half of the area of adjoining left and right image strips 113, 114.

In addition the stereoscopic viewing system 110 includes mask 112 comprised of a linear array of tri-elliptical lenses 118. Each tri-elliptical 118 is itself formed from three intersecting strip lenses of ellipsoid cross-section as perhaps best seen in detail in Figure 8. The function of each of these lenses 118 is as typically found in "lenticular" stereoscopic systems, being to refract the light received from collective left image strips 113 to a left eye 115 of a viewer and to also refract (bend) the light received from collective right image strips 114 to the right eye 116 of a viewer when located in a specified focal plane 119.

In this embodiment the lenses 118 are contiguously connected in a linear array as illustrated in Figure 6. The only masking of light information is performed by opaque strips 117 located, in this instance, directly on the raw image 111 as illustrated.

Figure 7 illustrates a further embodiment of the invention comprising a stereoscopic viewing system 210 having a raw image 211 and a mask 212 but wherein all other components are numbered as for the embodiment of Figure 6 where like components are utilised.

In this embodiment opaque mask elements are placed between each tri-elliptical lens 118 in the manner illustrated in Figure 7. The opaque strips 117 are also utilised applied directly to the raw image 211.

In this instance the width of the opaque mask elements 213 interconnecting the tri-elliptical lenses 118 is the dimension P.

With reference to Figure 8 a detailed cross section of the mask 212 of Figure 7 is illustrated showing the tri-elliptical 118 to be formed as part of an elongate strip of optical material 214 made from optical material having a refractive index between 1 and 2.

Particular materials which are suitable include clear plastic; glass, thermoset plastic (CR39); plexiglass; and acrylic resin in the form of methyl methacrylate (which has a specific refractive index of 1.49).

The strip 214 comprises a base elongate portion 215 into which one face has formed the tri-elliptical lens structure 118 and between which planar portions 216 having an opaque strip 217 applied thereover as illustrated in Figure 8.

Figure 9 illustrates an alternative mask 312 suitable for use with any of the previously mentioned embodiments of stereoscopic viewing system. The mask 312 comprises a linear array of spherical cross-section lenses in between which are located opaque joining portions 314 formed as a square cross-section block having a triangular cross section opaque portion 315 located therein as generally illustrated in Figure 9.

The surface of the circular cross-section lenses 313 can be profiled as a set of planar portions forming a segmented planar approximation 316 to a cylindrical or curved surface, also as illustrated in Figure 9.

The above describes only some embodiments of the present invention and modifications, obvious to those skilled in the art, can be made thereto without departing from the scope and spirit of the present invention.

INDUSTRIAL APPLICABILITY

Embodiments of the invention are applicable to stereoscopic viewing systems of many kinds including stereoscopic television systems where it is desired to provide a stereoscopic image to a viewer without the viewer needing to use glasses or other equivalent encumbrances.

CLAIMS

1. A stereoscopic viewing system comprising a raw image overlaid by a mask arranged so that a viewer can resolve a stereoscopic image derived from said raw image in a focal plane of predetermined width located a predetermined distance from said mask.

2. The system of claim 1 wherein said raw image is comprised of alternating left image strips and right image strips, both of pitch P.

3. The system of claim 2 wherein said mask includes vertical lenticular lens strips corresponding to said left and right image strips and arranged to refract light received therefrom so as to cause a stereoscopic image to be resolved by said viewer in said focal plane.

4. The system of claim 3 wherein said mask further includes opaque vertical strips interposed in between said lenticular lens strips.

5. The system of claim 4 wherein said opaque strips are of pitch P and overlay half the width of adjacent left and right image strips.

6. The system of any previous claim wherein said raw image includes raw image opaque strips interposed between said alternating left image strips and right image strips.

7. The system of any previous claim wherein said lenticular lens strips are in the form of tri-elliptical lenses.

8. The system of any previous claim wherein said lenticular lens strips are in the form of a circular cross-section lens.

9. The system of claim 8 wherein said circular cross-section lens is formed as a series of adjacent, planar approximations.

10. The system of any previous claim wherein said mask is formed as a base elongate portion of optical material into a first surface of which are formed lens elements.

11. The system of claim 10 wherein said base elongate portion includes opaque strips placed on said first surface between said lens elements.

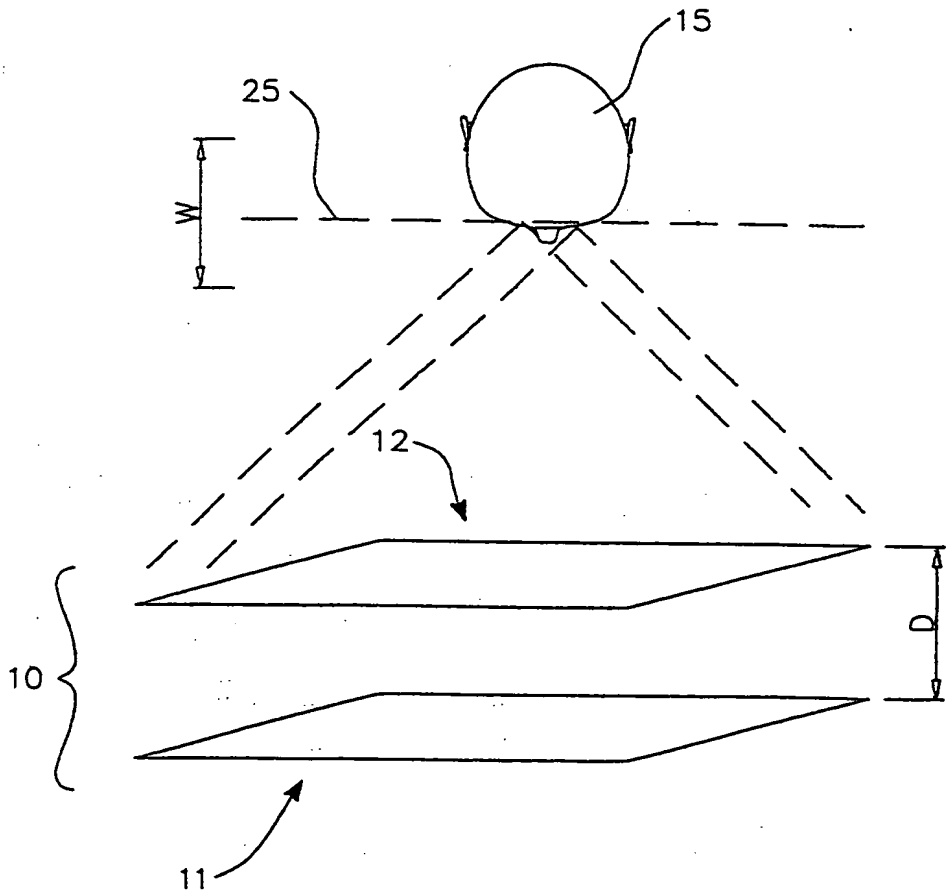


Fig. 1

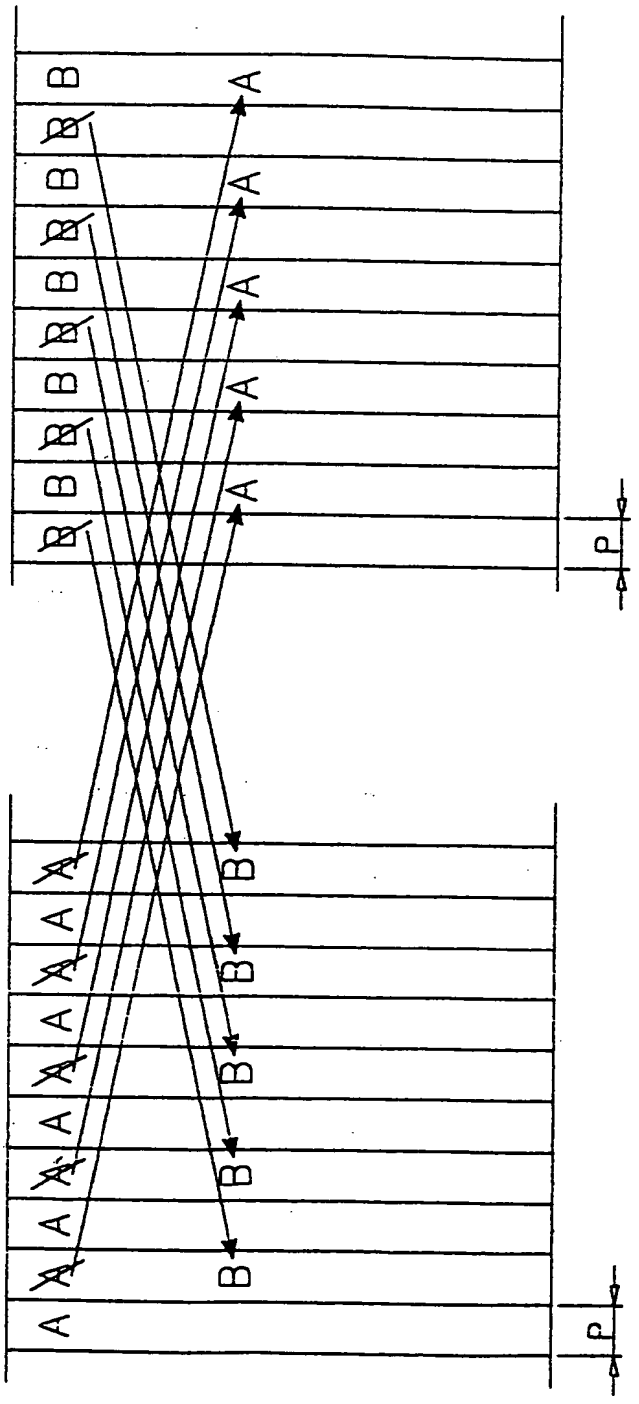


Fig. 2B

Fig. 2A

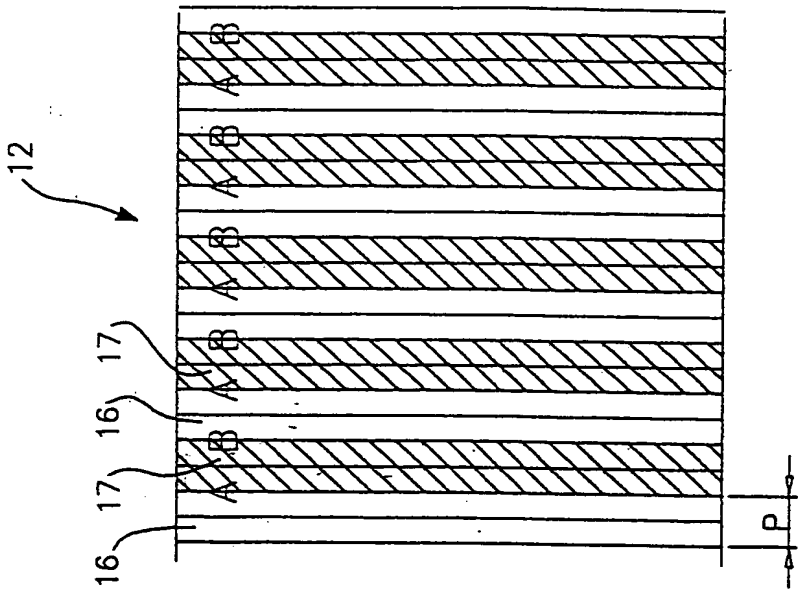


Fig. 3B

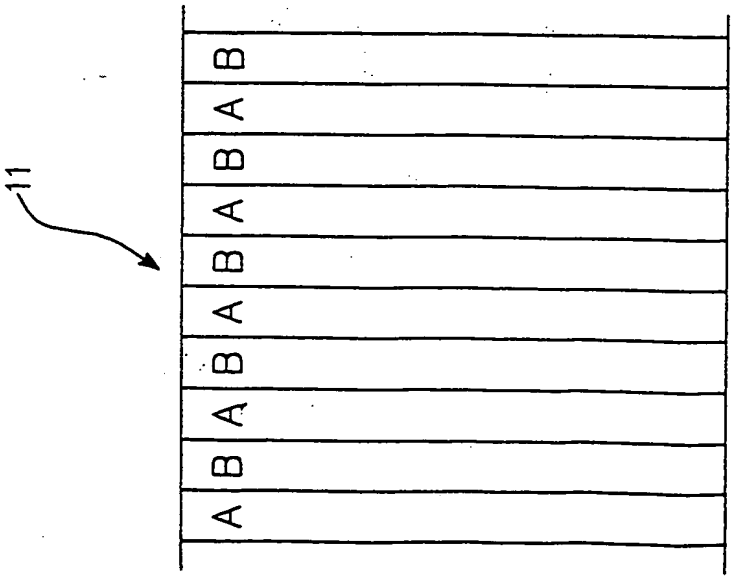


Fig. 3A

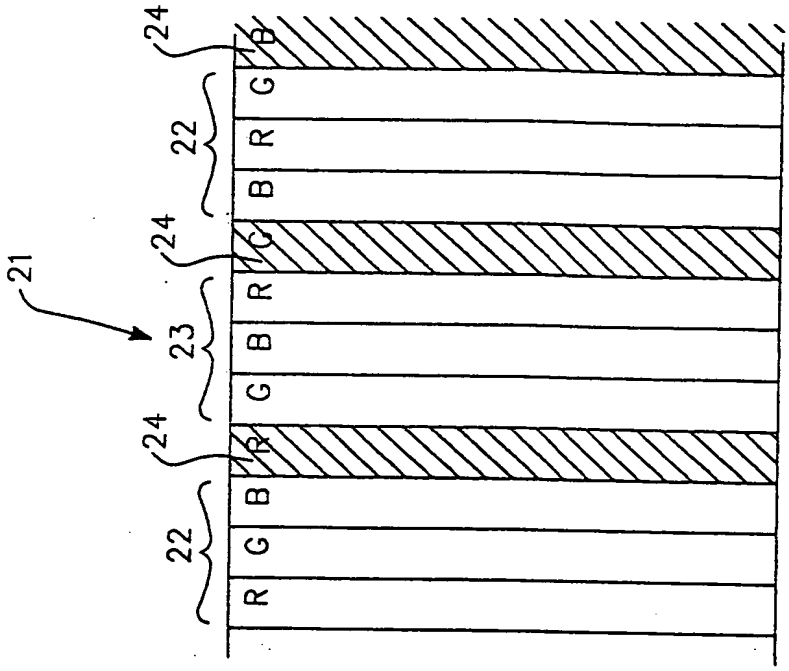


Fig. 4B

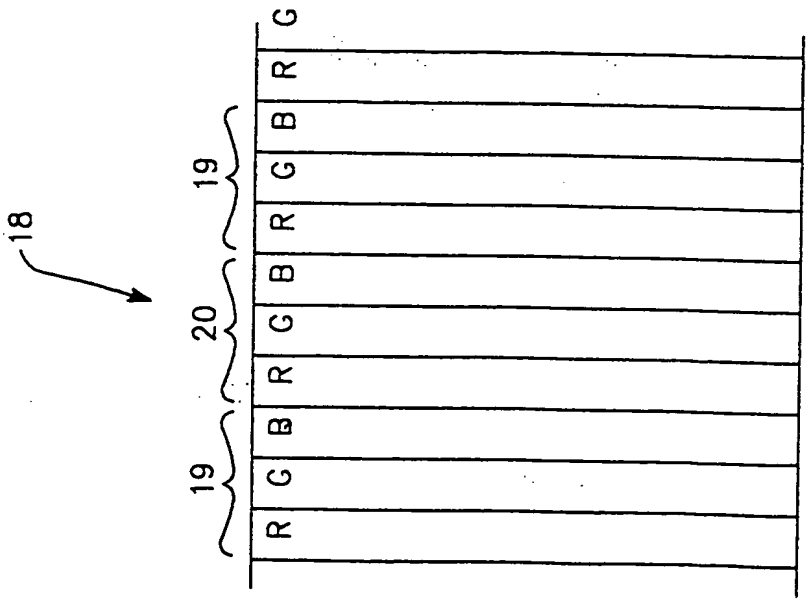


Fig. 4A

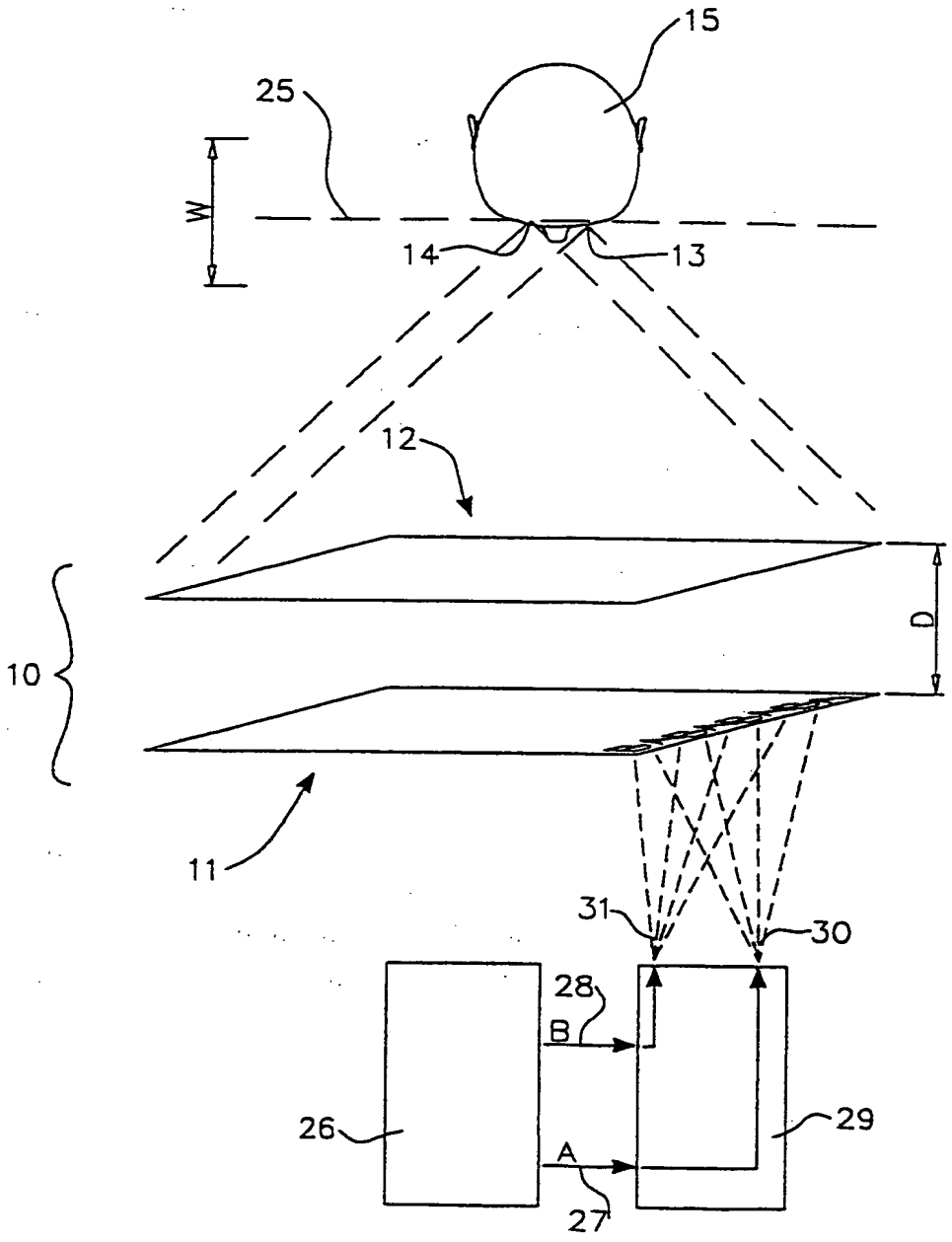


Fig. 5

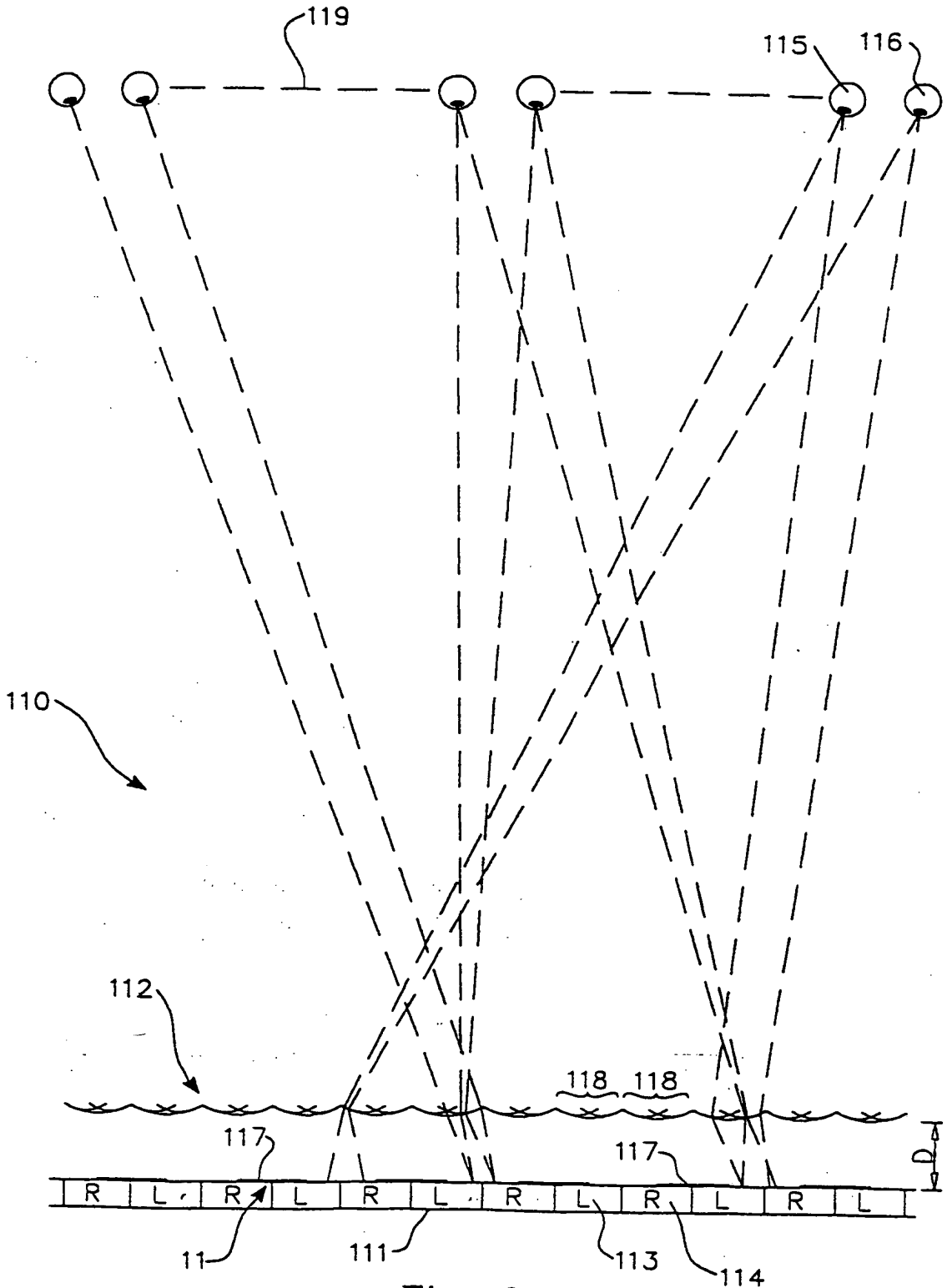

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Fig. 6

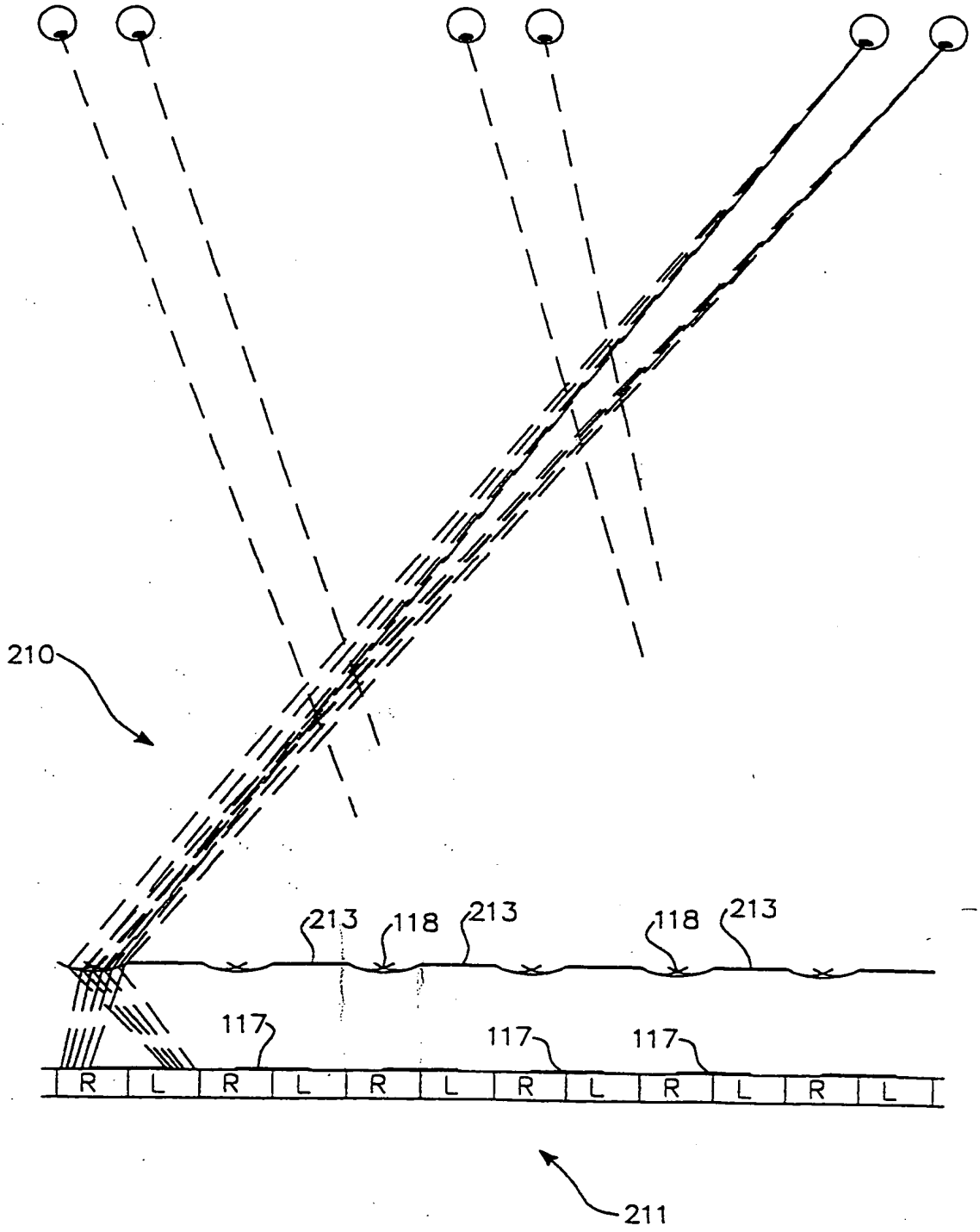

Fig. 7

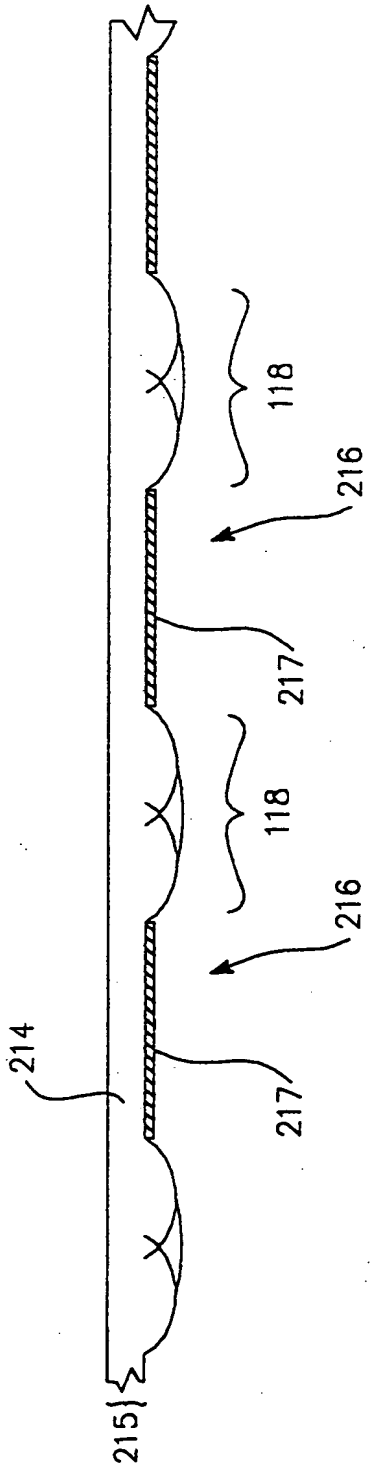

Fig. 8

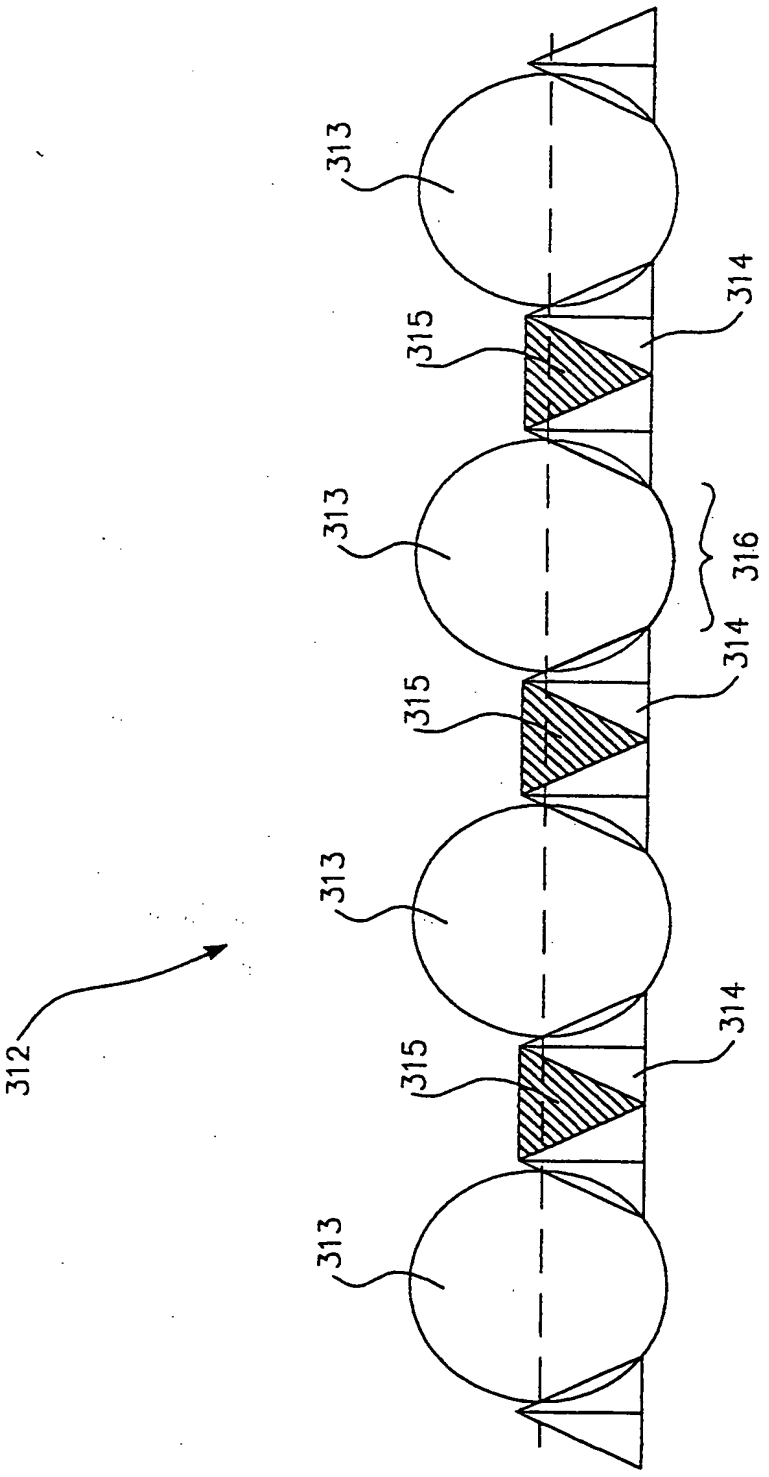

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 98/00635

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: H04N 13/00, 15/00; G02B 27/22; G03B 35/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC H04N 13/00, 15/00, 5/72; G02B 27/22; B44F 7/00; G03B 35/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT: STEREOSCOPIC AND IMAGE AND (MASK OR SCREEN OR DIFFUS: OR OPAQUE)
JAPIO: STEREOSCOPIC AND IMAGE AND (MASK OR SCREEN OR DIFFUS: OR OPAQUE)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU 13076/92 A (SCHENK AG) 15 October 1992 Page 4, line 11 - page 7, line 29; figs 1, 2 and 6	1-9
X	US 5049987A (HOPPENSTEIN) 17 September 1991 Column. 2 line 22-43; col 2. Line 53 - col 3, line 13; col. 7, line 58 - col. 8, line 43	1-9
X	US 4737840A (MORISHITA) 12 April 1988 Column 2, lines 55-65; figs 2-13	1-6

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 OCTOBER 1998	21 Oct 1998
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer SERINEL SAMUEL Telephone No.: (02) 6283 2382

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 98/00635

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0762177 A2 (THOMSON MULTIMEDIA) 12 March 1997 Whole document	1-6
Y	EP 0316465 A1 (DIMENSION TECHNOLOGIES, INC) 24 May 1989 Column 3, lines 31-43; figs 3 and 12	1-6
Y	EP 0226155 A2 (MEACHAM, G.B. Kirby) 24 June 1987 Page 2, line 21 - page 3, line 2; claim 1, figs 1 to 4.	1-6